



**[4910-13]**

## **DEPARTMENT OF TRANSPORTATION**

### **Federal Aviation Administration**

#### **14 CFR Part 25**

**[Docket No.FAA-2013-1040; Notice No. 25-13-39-SC]**

**Special Conditions:** Bombardier Inc., Models BD-500-1A10 and BD-500-1A11 series airplanes; Flight Envelope Protection: General Limiting Requirements.

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Notice of proposed special conditions.

**SUMMARY:** This action proposes special conditions for the Bombardier Inc. Models BD-500-1A10 and BD-500-1A11 series airplanes. These airplanes will have a novel or unusual design feature associated with a new control architecture and a full digital flight control system that provides flight envelope protections. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** Send your comments on or before **[insert a date 45 days after date of publication in the Federal Register]**.

**ADDRESSES:** Send comments identified by docket number FAA-2013-1040 using any of the following methods:

- Federal eRegulations Portal: Go to <http://www.regulations.gov/> and follow the online instructions for sending your comments electronically.
- Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE., Room W12-140, West Building Ground Floor, Washington, D.C., 20590-0001.
- Hand Delivery or Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except federal holidays.
- Fax: Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to <http://www.regulations.gov/>, including any personal information the commenter provides. Using the search function of the docket web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov/>.

Docket: Background documents or comments received may be read at <http://www.regulations.gov/> at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except federal holidays.

**FOR FURTHER INFORMATION CONTACT:** Joe Jacobsen, FAA, Airplane and Flight Crew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-2011; facsimile 425-227-1149.

## **SUPPLEMENTARY INFORMATION:**

### **Comments Invited**

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

We will consider all comments we receive on or before the closing date for comments. We may change these special conditions based on the comments we receive.

### **Background**

On December 10, 2009, Bombardier Inc. applied for a type certificate for their new Models BD-500-1A10 and BD-500-1A11 series airplanes (hereafter collectively referred to as “C-series”). The C-series airplanes are swept-wing monoplanes with a pressurized cabin. They share an identical supplier base and significant common design elements. The fuselage is aluminum alloy material, blended double-bubble fuselage, sized for nominal 5-abreast seating. Each airplane’s powerplant consists of two under wing Pratt and Whitney PW1524G ultra-high bypass, geared turbofan engines. Flight controls are fly-by-wire flight with two passive/uncoupled side sticks. Avionics includes five landscape primary cockpit displays. The dimension of the airplanes encompass a wingspan of 115 feet; a height of 37.75 feet; and a

length of 114.75 feet for the Model BD-500-1A10 and a length of 127 feet for the Model BD-500-1A11. Passenger capacity is designated as 110 for the Model BD-500-1A10 and 125 for the Model BD-500-1A11. Maximum takeoff weight is 131,000 pounds for the Model BD-500-1A10 and 144,000 pounds for the Model BD-500-1A11. Maximum takeoff thrust is 21,000 pounds for the Model BD-500-1A10 and 23,300 pounds for the Model BD-500-1A11. Range is 3,394 miles (5,463 kilometers) for both models of airplanes. Maximum operating altitude is 41,000 feet for both model airplanes.

Bombardier has developed comprehensive flight envelope protection features integral to the C-series electronic flight control system (EFCS) design. These flight envelope protection features include limitations on angle-of-attack, normal load factor, bank angle, pitch angle, and speed. To accomplish this flight envelope limiting, a significant change (or multiple changes) occurs in the EFCS control laws as the limit is approached or exceeded. When EFCS failure states occur, flight envelope protection features can likewise either be modified, or in some cases, eliminated. The current regulations were not written with these comprehensive flight envelope limiting systems in mind.

### **Type Certification Basis**

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.17, Bombardier Inc. must show that the C-series airplanes meet the applicable provisions of part 25 as amended by Amendments 25-1 through 25-129 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the C-series airplanes because of

a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the C-series airplanes must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36, and the FAA must issue a finding of regulatory adequacy under § 611 of Public Law 92-574, the "Noise Control Act of 1972."

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

### **Novel or Unusual Design Features**

The C-series airplanes will incorporate the following novel or unusual design features: new control architecture and a full digital flight control system that provides comprehensive flight envelope protections.

### **Discussion**

The applicable airworthiness regulation in this instance is 14 CFR 25.143. The purpose of § 25.143 is to verify that any operational maneuvers conducted within the operational envelope can be accomplished smoothly with average piloting skill and without exceeding any

structural limits. The pilot should be able to predict the airplane response to any control input. During the course of the flight test program, the pilot determines compliance with § 25.143 through primarily qualitative methods. During flight test, the pilot should evaluate all of the following:

- The interface between each protection function;
- Transitions from one mode to another;
- The aircraft response to intentional dynamic maneuvering, whenever applicable, through dedicated maneuvers;
- General controllability assessment;
- High speed characteristics; and
- High angle-of-attack.

Section 25.143, however, does not adequately ensure that the novel or unusual features of the C-series airplanes will have a level of safety equivalent to that of existing standards. These special conditions are therefore required to accommodate the flight envelope limiting systems in the C-series airplanes. The additional safety standards in these special conditions will ensure a level of safety equivalent to that of existing standards.

### **Applicability**

As discussed above, these special conditions are applicable to the Models BD-500-1A10 and BD-500-1A11 series airplanes. Should Bombardier Inc. apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

## **Conclusion**

This action affects only certain novel or unusual design features on two model series of airplanes. It is not a rule of general applicability.

## **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

## **The Proposed Special Conditions**

Accordingly, the Federal Aviation Administration (FAA) proposes the following special conditions as part of the type certification basis for the Bombardier Inc. Models BD-500-1A10 and BD-500-1A11 series airplanes.

### **1. General Limiting Requirements:**

- a. Onset characteristics of each envelope protection feature must be smooth, appropriate to the phase of flight and type of maneuver, and not in conflict with the ability of the pilot to satisfactorily change airplane flight path, speed, or attitude as needed.
- b. Limit values of protected flight parameters (and if applicable, associated warning thresholds) must be compatible with the following:
  - i. Airplane structural limits,
  - ii. Required safe and controllable maneuvering of the airplane, and
  - iii. Margins to critical conditions. Unsafe flight characteristics/conditions must not result if dynamic maneuvering, airframe and system tolerances (both

manufacturing and in-service), and non-steady atmospheric conditions, in any appropriate combination and phase of flight, can produce a limited flight parameter beyond the nominal design limit value.

- c. The airplane must be responsive to intentional dynamic maneuvering to within a suitable range of the parameter limit. Dynamic characteristics such as damping and overshoot must also be appropriate for the flight maneuver and limit parameter in question.
  - d. When simultaneous envelope limiting is engaged, adverse coupling or adverse priority must not result.
2. Failure States: Electronic flight control system failures (including sensor) must not result in a condition where a parameter is limited to such a reduced value that safe and controllable maneuvering is no longer available. The crew must be alerted by suitable means if any change in envelope limiting or maneuverability is produced by single or multiple failures of the electronic flight control system not shown to be extremely improbable.

Issued in Renton, Washington, on November 29, 2013.

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